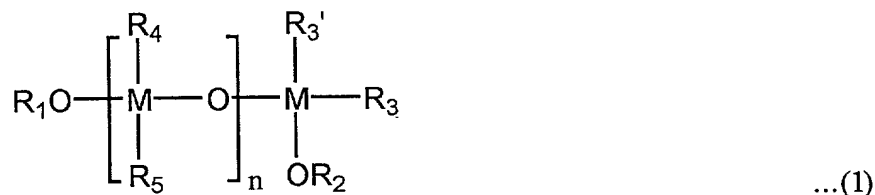


What is claimed is:

1. A protective layer composition comprising a metal compound of formula (1) below, a mercapto compound of formula (3) or (4) below, and a polar solvent:



where M is selected from the group consisting of Si, Ti, Sn, and Zr;

R₁ is a C₁-C₂₀ alkyl group or -M(R₁₄R₁₅R₁₆) where R₁₄, R₁₅, and R₁₆ are, independently, a C₁-C₂₀ alkyl group, a C₁-C₂₀ alkoxy group, or a C₆-C₂₀ aryl group;

R₂ is a C₁-C₂₀ alkyl group;

at least one of R₃ and R₃N is a C₁-C₂₀ alkoxy group, and the remaining group is a C₁-C₂₀ alkyl group, a C₁-C₂₀ alkoxy group, a C₂-C₂₀ alkylene group, or a C₆-C₂₀ aryl group;

at least one of R₄ and R₅ is a C₁-C₂₀ alkoxy group, and the remaining group is a C₁-C₂₀ alkyl group, a C₂-C₂₀ alkylene group, or a C₆-C₂₀ aryl group; and

n is an integer from 0 to 20,



where R₉ is a C₁-C₂₀ alkyl group, a C₁-C₂₀ alkyl group with a hydroxy group, a C₁-C₂₀ hydroxyalkyl group with a hydroxy substituent, or -(CH₂)_kCOOH, where k is an integer from 1 to 10, and

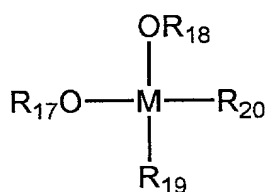


where R₁₀ is a C₁-C₂₀ alkyl group; R₁₁ and R₁₂ are, independently, a C₁-C₂₀ alkyl group, a C₁-C₂₀ alkoxy group, or a C₁-C₂₀ alkyl group with a mercapto group; and R₁₃ is a C₁-C₂₀ alkyl group with a mercapto (-SH) group.

2. The protective layer composition of claim 1, wherein the mercapto compound of said formula (3) or (4) is at least one selected from the group consisting of 3-mercaptopropyltrimethoxysilane,
 3-mercaptopropylmethyldimethoxysilane, 3-mercapto-1,2-propanediol,
 1-mercapto-2-propanol, 3-mercaptopropionic acid,
 di-(3-mercaptopropyl)dimethoxysilane, and tris-(3-mercaptopropyl)methoxysilane,
 and the mercapto compound is contained in an amount of 1-15 parts by weight based on 100 parts by weight of the metal compound of said formula (1).

3. The protective layer composition of claim 1, wherein the metal compound of said formula (1) is at least one selected from the group consisting of tetraethylorthosilicate, tetramethylorthosilicate, methyltrimethoxyorthosilicate, vinyltriethoxysilane, 3-glycidoxypropyltrimethoxysilane, and phenyltriethoxysilane.

4. The protective layer composition of claim 1, further comprising a metal compound of formula (5) below:



...(5)

where M is selected from the group consisting of Si, Ti, Sn, and Zr;

R₁₇ and R₁₈ are, independently, a C₁-C₂₀ alkyl group or a C₆-C₂₀ aryl group;

and

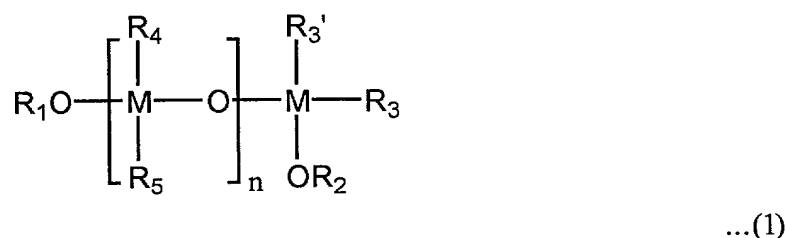
R₁₉ and R₂₀ are, independently, a C₁-C₂₀ alkyl group, a C₂-C₂₀ alkylene group, or a C₆-C₂₀ aryl group.

5. The protective layer composition of claim 4, wherein the metal compound of said formula (5) is at least one selected from the group consisting of dimethyldimethoxyorthosilicate, diethyldimethoxyorthosilicate,
 dimethyldiethoxyorthosilicate, and diethyldiethoxyorthosilicate.

6. The protective layer composition of claim 1, wherein the polar solvent is at least one selected from the group consisting of ethanol, methanol, butanol, isopropanol, methylethylketone, methylcellosolve, and ethylcellosolve, and the polar solvent is contained in an amount of 1000-4000 parts by weight based on 100 parts by weight of the metal compound of said formula (1).

7. The protective layer composition of claim 1, further comprising a hydrolytic catalyst in an amount of 0.1-0.9 mole with respect to 1 mole of the metal compound of said formula (1), and the hydrolytic catalyst is at least one selected from the group consisting of nitric acid, hydrochloric acid, phosphoric acid, and sulfuric acid.

8. A spray-coated layer composition comprising a metal compound of formula (1) below, fluoroalkylsilane of formula (2) below, a mercapto compound of formula (3) or (4) below, and a polar solvent:



where M is selected from the group consisting of Si, Ti, Sn, and Zr;

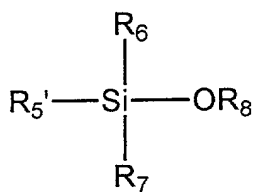
R_1 is a C_1 - C_{20} alkyl group or $-M(R_{14}R_{15}R_{16})$ where R_{14} , R_{15} , and R_{16} are, independently, a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkoxy group, or a C_6 - C_{20} aryl group;

R_2 is a C_1 - C_{20} alkyl group;

at least one of R_3 and R_3N is a C_1 - C_{20} alkoxy group, and the remaining group is a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkoxy group, a C_2 - C_{20} alkylene group, or a C_6 - C_{20} aryl group;

at least one of R_4 and R_5 is a C_1 - C_{20} alkoxy group, and the remaining group is a C_1 - C_{20} alkyl group, a C_2 - C_{20} alkylene group, or a C_6 - C_{20} aryl group; and

n is an integer from 0 to 20,

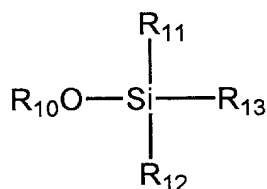


...(2)

where R₅N is a fluorinated C₁-C₂₀ alkyl group; R₆ and R₇ are, independently, a C₁-C₂₀ alkoxy group or a fluorinated C₁-C₂₀ alkyl group; and R₈ is a C₁-C₂₀ alkyl group,



where R₉ is a C₁-C₂₀ alkyl group, a C₁-C₂₀ alkyl group with a hydroxy group, a C₁-C₂₀ hydroxyalkyl group with a hydroxy substituent, or -(CH₂)_kCOOH, where *k* is an integer from 1 to 10, and



...(4)

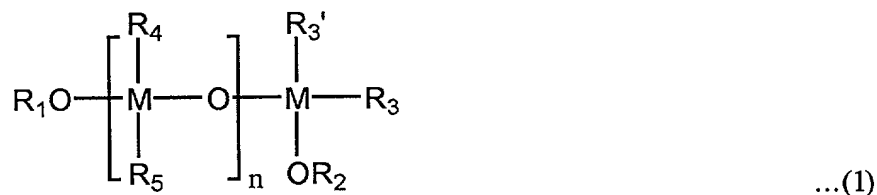
where R₁₀ is a C₁-C₂₀ alkyl group; R₁₁ and R₁₂ are, independently, a C₁-C₂₀ alkyl group, a C₁-C₂₀ alkoxy group, or a C₁-C₂₀ alkyl group with a mercapto group; and R₁₃ is a C₁-C₂₀ alkyl group with a mercapto (-SH) group.

9. The spray-coated layer composition of claim 8, wherein the fluoroalkylsilane of said formula (2) is at least one selected from the group consisting of heptadecafluorodecyltriethoxysilane, pentadecafluorohexyltrimethoxysilane, heptadecafluorodecyltrimethoxysilane, heptadecafluorodecyltriisopropoxysilane, heptadecafluorodecyltributoxysilane, di-(heptadecafluorodecyl)diethoxysilane, and tris-(heptadecafluorodecyl)ethoxysilane, and the fluoroalkylsilane of said formula (2) is contained in an amount of 1-15 parts by weight based on 100 parts by weight of the metal compound of formula (1).

14. The spray-coated layer composition of claim 8, wherein the polar solvent is at least one selected from the group consisting of ethanol, methanol, butanol, isopropanol, methylethylketone, methylcellosolve, and ethylcellosolve, and the polar solvent is contained in an amount of 1000-4000 parts by weight based on 100 parts by weight of the metal compound of said formula (1).

15. The spray-coated layer composition of claim 9, further comprising a hydrolytic catalyst in an amount of 0.1-0.9 mole with respect to 1 mole of the metal compound of said formula (1), and the hydrolytic catalyst is at least one selected from the group consisting of nitric acid, hydrochloric acid, phosphoric acid, and sulfuric acid.

16. A transparent conductive layer comprising a conductive layer containing a metal oxide and a protective layer formed on the conductive layer, the protective layer containing a hydrolyzed and polycondensated product of a metal compound of formula (1) below and at least one of a mercapto compound of formula (3) or (4) below and its hydrolyzed and polycondensated product:



where M is selected from the group consisting of Si, Ti, Sn, and Zr;

R₁ is a C₁-C₂₀ alkyl group or -M(R₁₄R₁₅R₁₆) where R₁₄, R₁₅, and R₁₆ are, independently, a C₁-C₂₀ alkyl group, a C₁-C₂₀ alkoxy group, or a C₆-C₂₀ aryl group;

R₂ is a C₁-C₂₀ alkyl group;

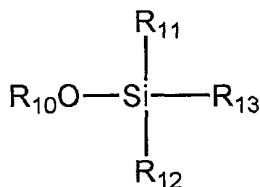
at least one of R₃ and R₃N is a C₁-C₂₀ alkoxy group, and the remaining group is a C₁-C₂₀ alkyl group, a C₁-C₂₀ alkoxy group, a C₂-C₂₀ alkylene group, or a C₆-C₂₀ aryl group;

at least one of R₄ and R₅ is a C₁-C₂₀ alkoxy group, and the remaining group is a C₁-C₂₀ alkyl group, a C₂-C₂₀ alkylene group, or a C₆-C₂₀ aryl group; and

n is an integer from 0 to 20,



where R_9 is a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkyl group with a hydroxy group, a C_1 - C_{20} hydroxyalkyl group with a hydroxy substituent, or $-(CH_2)_kCOOH$, where k is an integer from 1 to 10, and



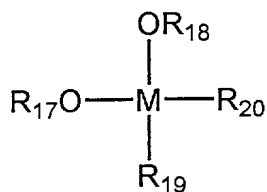
$\dots(4)$

where R_{10} is a C_1 - C_{20} alkyl group; R_{11} and R_{12} are, independently, a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkoxy group, or a C_1 - C_{20} alkyl group with a mercapto group; and R_{13} is a C_1 - C_{20} alkyl group with a mercapto ($-SH$) group.

17. The transparent conductive layer of claim 16, wherein the mercapto compound of said formula (3) or (4) is at least one selected from the group consisting of 3-mercaptopropyltrimethoxysilane, 3-mercaptopropylmethyldimethoxysilane, 3-mercaptopropyl-1,2-propanediol, 1-mercaptopropyl-2-propanol, 3-mercaptopropionic acid, di-(3-mercaptopropyl)dimethoxysilane, and tris-(3-mercaptopropyl)methoxysilane, and the mercapto compound is contained in an amount of 1-15 parts by weight based on 100 parts by weight of the metal compound of said formula (1).

18. The transparent conductive layer of claim 16, wherein the metal compound of said formula (1) is at least one selected from the group consisting of tetraethylorthosilicate, tetramethylorthosilicate, methyltrimethoxyorthosilicate, vinyltriethoxysilane, 3-glycidoxypentyltrimethoxysilane, and phenyltriethoxysilane.

19. The transparent conductive layer of claim 16, wherein the protective layer further contains a hydrolyzed and polycondensated product of a metal compound of formula (5) below:



...(5)

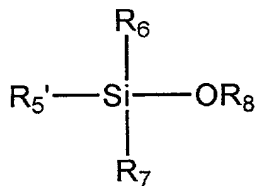
where M is selected from the group consisting of Si, Ti, Sn, and Zr;

R₁₇ and R₁₈ are, independently, a C₁-C₂₀ alkyl group or a C₆-C₂₀ aryl group;
and

R₁₉ and R₂₀ are, independently, a C₁-C₂₀ alkyl group, a C₂-C₂₀ alkylene group,
or a C₆-C₂₀ aryl group.

20. The transparent conductive layer of claim 19, wherein the metal compound of said formula (5) is at least one selected from the group consisting of dimethyldimethoxyorthosilicate, diethyldimethoxyorthosilicate, dimethyldiethoxyorthosilicate, and diethyldiethoxyorthosilicate.

21. The transparent conductive layer of claim 16, further comprising, on the protective layer, a spray-coated layer containing a hydrolyzed and polycondensated product of the metal compound of said formula (1), at least one of fluoroalkylsilane of formula (2) below and its hydrolyzed and polycondensated product, and at least one of a mercapto compound of said formula (3) or (4) and its hydrolyzed and polycondensated product:

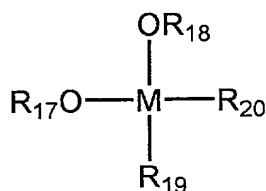


...(2)

where R₅N is a fluorinated C₁-C₂₀ alkyl group; R₆ and R₇ are, independently, a C₁-C₂₀ alkoxy group or a fluorinated C₁-C₂₀ alkyl group; and R₈ is a C₁-C₂₀ alkyl group.

22. The transparent conductive layer of claim 21, wherein the spray-coated layer is formed as a non-continuous layer.

23. The transparent conductive layer of claim 21, wherein the spray-coated layer further contains a hydrolyzed and polycondensated product of a metal compound of formula (5) below:



...(5)

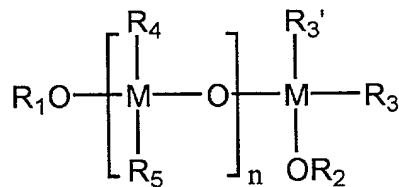
where M is selected from the group consisting of Si, Ti, Sn, and Zr;

R₁₇ and R₁₈ are, independently, a C₁-C₂₀ alkyl group or a C₆-C₂₀ aryl group;

and

R₁₉ and R₂₀ are, independently, a C₁-C₂₀ alkyl group, a C₂-C₂₀ alkylene group, or a C₆-C₂₀ aryl group.

24. A transparent conductive layer comprising a conductive layer containing a metal oxide and a protective layer and spray-coated layer sequentially formed to protect the conductive layer, the spray-coated layer containing a hydrolyzed and polycondensated product of a metal compound of formula (1) below, at least one of fluoroalkylsilane of formula (2) below and its hydrolyzed and polycondensated product, and at least one of a mercapto compound of formula (3) or (4) below and its hydrolyzed and polycondensated product, and the protective layer containing a hydrolyzed and polycondensated product of the metal compound of said formula (1):



...(1)

where M is selected from the group consisting of Si, Ti, Sn, and Zr;

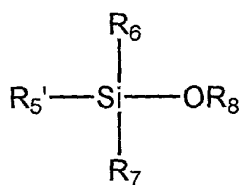
R_1 is a C_1 - C_{20} alkyl group or $-M(R_{14}R_{15}R_{16})$ where R_{14} , R_{15} , and R_{16} are, independently, a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkoxy group, or a C_6 - C_{20} aryl group;

R_2 is a C_1 - C_{20} alkyl group;

at least one of R_3 and R_3N is a C_1 - C_{20} alkoxy group, and the remaining group is a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkoxy group, a C_2 - C_{20} alkylene group, or a C_6 - C_{20} aryl group;

at least one of R_4 and R_5 is a C_1 - C_{20} alkoxy group, and the remaining group is a C_1 - C_{20} alkyl group, a C_2 - C_{20} alkylene group, or a C_6 - C_{20} aryl group; and

n is an integer from 0 to 20,



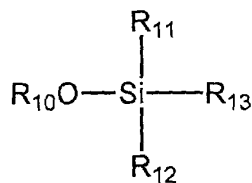
...(2)

where R_5N is a fluorinated C_1 - C_{20} alkyl group; R_6 and R_7 are, independently, a C_1 - C_{20} alkoxy group or a fluorinated C_1 - C_{20} alkyl group; and R_8 is a C_1 - C_{20} alkyl group,



...(3)

where R_9 is a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkyl group with a hydroxy group, a C_1 - C_{20} hydroxyalkyl group with a hydroxy substituent, or $-(CH_2)_kCOOH$, where k is an integer from 1 to 10, and



...(4)

where R_{10} is a C_1 - C_{20} alkyl group; R_{11} and R_{12} are, independently, a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkoxy group, or a C_1 - C_{20} alkyl group with a mercapto group; and R_{13} is a C_1 - C_{20} alkyl group with a mercapto ($-SH$) group.

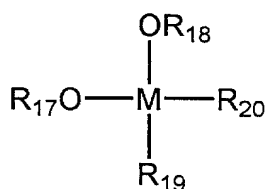
25. The transparent conductive layer of claim 24, wherein the spray-coated layer is formed as a non-continuous layer.

26. The transparent conductive layer of claim 24, wherein the fluoroalkylsilane of said formula (2) is at least one selected from the group consisting of heptadecafluorodecyltriethoxysilane, pentadecafluorohexyltrimethoxysilane, heptadecafluorodecyltrimethoxysilane, heptadecafluorodecyltriisopropoxysilane, heptadecafluorodecyltributoxysilane, di-(heptadecafluorodecyl)diethoxysilane, and tris-(heptadecafluorodecyl)ethoxysilane, and the fluoroalkylsilane of said formula (2) is contained in an amount of 1-15 parts by weight based on 100 parts by weight of the metal compound of formula (1).

27. The transparent conductive layer of claim 24, wherein the mercapto compound of said formula (3) or (4) is at least one selected from the group consisting of 3-mercaptopropyltrimethoxysilane, 3-mercaptopropylmethyldimethoxysilane, 3-mercapto-1,2-propanediol, 1-mercapto-2-propanol, 3-mercaptopropionic acid, di-(3-mercaptopropyl)dimethoxysilane, and tris-(3-mercaptopropyl)methoxysilane, and the mercapto compound is contained in an amount of 1-15 parts by weight based on 100 parts by weight of the metal compound of said formula (1).

28. The transparent conductive layer of claim 24, wherein the metal compound of said formula (1) is at least one selected from the group consisting of tetraethylorthosilicate, tetramethylorthosilicate, methyltrimethoxyorthosilicate, 3-glycidoxypropyltrimethoxysilane, vinyltriethoxysilane, and phenyltriethoxysilane.

29. The transparent conductive layer of claim 24, wherein the spray-coated layer further contains a hydrolyzed and polycondensated product of a metal compound of formula (5) below:



...(5)

where M is selected from the group consisting of Si, Ti, Sn, and Zr;

R₁₇ and R₁₈ are, independently, a C₁-C₂₀ alkyl group or a C₆-C₂₀ aryl group;

and

R₁₉ and R₂₀ are, independently, a C₁-C₂₀ alkyl group, a C₂-C₂₀ alkylene group,
or a C₆-C₂₀ aryl group.

30. The transparent conductive layer of claim 29, wherein the metal compound of said formula (5) is at least one selected from the group consisting of dimethyldimethoxyorthosilicate, diethyldimethoxyorthosilicate, dimethylethoxyorthosilicate, and diethyldiethoxyorthosilicate.

31. An image display device employing the transparent conductive layer of claim 16.

32. The image display device of claim 31, wherein the transparent conductive layer is formed on a panel of a cathode ray tube.

33. An image display device employing the transparent conductive layer of claim 24.

34. The image display device of claim 33, wherein the transparent conductive layer is formed on a panel of a cathode ray tube.